

## TITILE OF THE INVENTION

Conductive Pattern Producing Method and Its Applications

## BACKGROUND OF THE INVENTION

This invention relates to a conductive pattern producing method, and more particularly, relates to an improvement for conductive pattern producing method which makes the pattern thus produced by the method more credible.

Heretofore, the interest of operators to manufacture liquid crystal devices which comprises a pair of glass substrates and electrode pattern including addressing lines and signal lines for producing a matrix arrangement, is directed to how to form a pattern on the substrates without defect and with a high reliability of the pattern. Also the device generally includes an IC chip for driving the liquid crystal device. The facilitataion and credibility of the connection between the IC chip and the pattern is always in question. Particularly, in the case that a pattern is formed on a glass substrate, there likely occur fissures in the pattern which cause disconnection of circuitry.

## SUMMARY OF THE INVENTION

It is therefore an object of the invention to provide a method for producing a credible pattern.

In order to accomplish the object of the invention, patterns are manufactured with double-layered film.

## BRIEF DESCRIPTION OF THE INVENTION

Figs.1(A) to 1(D) are cross sectional views showing a method of manufacturing a conductive pattern in accordance with the present invention.

Figs.2(A) and 2(B) are a plan view and cross sectional partial view showing a pattern fromed in accordance with the present invention.

Figs.3(A) and 3(B) are cross sectional partial views showing contact portions between IC chips and conductive patterns in accordance with the present invention.

Figs.4(A) and 4(B) are graphical diagrams of temperature curves which are used in methods in accordance with the present invention.

Figs.5(A) to 5(C) are cross sectional views showing a method in accordance with the present invention.

Fig.6 is a cross sectional view showing the contact portion between an IC chip and the conductive pattern produced by the method as illustrated in Figs.5(A) to 5(C).

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figs.1(A) to 1(D), a method of forming a conductive pattern on a substrate for mounting thereon an IC chip in accordance with the present invention. On a glass substrate for liquid crystal device, only a portion of which is illustrated in the figures, a conductive pattern is formed by offset screen printing with a conductive paste (Fig.1(A)). The conductive paste for the pattern is prepared by mixing, with an oil emulsion, "cover silver paste" (Prod No. 61900234) distributed by Detmeron, a manufacture of FRG. The thickness of the pattern is 10 microns. Then, the substrate is baked in a nitrogen atmosphere in accordance with a temperature curve shown in Fig.4(A), so that formed are a contact region 2a and a sintered region largely consisting of silver (Fig.1(B)). Also, on a portion of the pattern, another pattern to make a thick portion is formed in the same manner by printing and baking (Figs.1(C) and 1(D)). The thickness of the thick portion is 30 microns after baking. Instead of printing, the pattern can be formed of ITO by sputtering with a good contact and a good conductivity. Figs.2(A) and 2(B) are plan view and a cross sectional view showing the whole pattern on the substrate formed as explained above.

After the formation of the pattern, a transparent adhesive of epoxy resin mixed with Ni particles having 15 microns in average diameter is applied to the surface of the substrate which is to face the bottom surface and the electrode pads of an IC. The Ni particles are added into at 50 mg per each 5g of the adhesive. Then, the IC chip is mounted on the substrate with its aluminium pads contacting corresponding pads of the thick portion of the pattern, and the epoxy resin is hardened at 180 °C while pressing the IC against the substrate for 20 minutes with a force of 3 Kg using a jig. During the mounting of the IC chip,

the alignment of the pads of the IC chip with the pattern on the substrate is checked by viewing the both from the bottom of the substrate through the transparent resin.

A resin which can be cured by a UV light may be also used as the adhesive. In this alternative, the resin is irradiated with a UV light through the transparent substrate.

Fig.3(A) is a partial cross section view showing the contact of the IC chip 5 with the substrate 1 after the hardening of the epoxy adhesive. The distance between the Al pad 8 and the top of the thick portion 3 is designed 3 microns in which the Ni particles are caught and make the resistance of the contact low. Other particles contained in the epoxy resin are situated between the IC chip and the substrate with 30 microns in distance, and do not damage the IC chip and the pattern 2 on the substrate 1. The area of the thick portion is preferably smaller than that of the corresponding pad of the pattern.

Next, a second embodiment of the invention is described. After the formation of the pattern by printing and baking in the same manner as the pattern 2 of the preceding embodiment, a thick portion 3 is formed by coating the prescribed portion with DAP1 (No.61901143), a conductive adhesive distributed by Detmeron. Then, the IC chip is mounted on the substrate with its aluminium pads contacting corresponding lands of the thick portion of the pattern and pressed against the substrate with a jig, and the substrate is baked in accordance with the temperature curve shown in Fig.4(B). Fig.3(B) is a cross sectional view showing the electrical connection between the IC chip and the pattern in accordance with this embodiment. By this embodiment, the method of the present invention brings the advantage that a few number of processing steps are required for mounting an IC chip and making necessary contact with the IC chip.

Referring to Figs.5(A) to 5(C), a third embodiment of the invention is illustrated. In Fig.5(A), a glass substrate 1 is coated by printing with a conductive paste consisting of Cu particles dispersed in a phenol resin, in order to form a prescribed pattern 11 including electrode lines for making contact

with counterpart pads of the IC chip. The average diameter of the Cu particle is 5-10 microns. This conductive paste coating is then baked at 60 °C for 10 minutes and becomes thin by shrinking. The baked layer 11 might have a fissure 12.

Then, another layer 13 of the Cu conductive paste is superimposed over the layer 11 by printing on the baked Cu layer as shown in Fig.5(B). The overlying Cu layer is also baked at 60°C for 10 minutes. The fissure 12 has to be mended by this overlying pattern. The dispersion of the double-layered pattern in thickness is about 30 microns. The double-layered pattern is then pressed to produce an even top surface 14. The thickness of the double-layered pattern becomes about 20 microns after pressing. On the pattern is mounted an IC chip whose electrode pads to be made contact with the patterns are given Au bumps by plating and the IC chip is pressed against the substrate with an adhesive resin securing the IC chip in place.

While a description has been made for several embodiments, the present invention should be limited only by the appended claims and should not be limited by the particular examples.